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NEST-SITE SELECTION BY SAGE THRASHERS IN SOUTHEASTERN IDAHO

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ABSTRACT.—Nest sites selected by Sage Thrashers (*Oreoscoptes montanus*) in southeastern Idaho were characterized and compared with available habitat. Microhabitats within 5 m of nests had taller and more aggregated shrubs and less bare ground than the study area in general. Big sagebrush (*Artemisia tridentata wyomingensis*) plants used for nesting were taller than average available shrubs, had greater foliage density, were more often living, and more frequently had branches and foliage within 30 cm of the ground. Nest placement was specific with respect to relative nest height and distance from the top and perimeter of the support shrub. Sage Thrashers disproportionately used easterly exposures and underused westerly exposures for their nests.

Key words: Sage Thrasher, big sagebrush, shrubsteppe, Idaho, nest-site selection.

Choice of nest sites represents habitat selection on a small spatial scale (e.g., MacKenzie et al. 1982, Stauffer and Best 1986, Bekoff et al. 1987). Availability and suitability of nest sites may govern the composition of bird communities and may structure species-habitat relationships as much as do the availability of food and other resources (Martin 1988). Presumbably, patterns of nest-site selection have evolved as a result of selective pressures that have maximized nesting success. In particular, predation (e.g., Murphy 1983, Belles-Isles and Picman 1986) and microclimate (e.g., Pleszczynska 1978, Ferguson and Siegfried 1989) have been implicated as major agents in molding nest-site selection strategies.

The Sage Thrasher (*Oreoscoptes montanus*) is a common breeding bird in sagebrush-shrubsteppe communities of the western United States (Wiens and Rotenberry 1981). Previous studies of nest-site selection by Sage Thrashers (Reynolds and Rich 1978, Rich 1978, 1980, Reynolds 1981) were limited in that only a few parameters (e.g., nest height, substrate height) were investigated. Our objective was to provide a more thorough analysis of Sage Thrasher nest-site selection, including characterization of nest-site microhabitat, nest substrates, and nest placement within substrates. Further, we measured aspects of available habitat with which to compare nest sites.

STUDY AREA AND METHODS

The study area, consisting of 25 ha of sagebrush shrubsteppe on the upper Snake River plain 11 km south of Howe, Idaho, is administered by the U.S. Department of Energy as part of the Idaho National Engineering Laboratory (INEL). Vegetation is dominated by big sagebrush (*Artemisia tridentata wyomingensis*), green rabbitbrush (*Chrysothamnus viscidiflorus*), and scattered bunchgrasses. Forbs are sparse and ephemeral, litter accumulations are scant, and much of the ground is bare. In 1980, four 6.25-ha plots (250 m × 250 m) were established and gridded throughout at 25-m intervals with steel stakes affixed with colored plastic flagging.

Data were collected during the breeding seasons of 1980–1984. Nests were located by using a rope-drag technique (Petersen and Best 1985) to flush adults from their nests. Nests also were discovered by observing adults feeding young, and many nests were found incidental to other activities. Each year several nests were discovered after being abandoned, and these were included in the sample. Nests that had deteriorated or were suspected to have been built before the current year were excluded.

Habitat characteristics of each plot were quantified in June each year by using 20 × 50-cm quadrats (Daubenmire 1959) and line intercept (Canfield 1941). Each year one to

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four quadrats were placed 2.5 or 5 m from each grid marker (in different locations each year); percent coverage of rabbitbrush, grasses, forbs, litter, and bare ground was estimated. Additionally, the height of all sagebrush plants included totally or partially within quadrats was recorded, and the condition of each sagebrush plant was noted as dead, 25%, 50%, 75%, or 100% living. We also qualitatively estimated density of foliage on the living portions of shrubs as low, intermediate, or high. Canopy continuity (presence or absence of gaps more than 20 cm across) of each sagebrush plant was recorded, and the profile (presence or absence of any branches or foliage within 30 cm of the ground) of sagebrush plants greater than 40 cm tall was noted.

Canopy coverage and dispersion of sagebrush were estimated by line intercept. Each year 10–25 samples were taken near grid markers on each plot, different grid markers being used each year. These samples were regularly spaced to provide an even distribution of sampling effort across the plot. For each sample we recorded line intercept of sagebrush and distance between adjacent sagebrush plants that were intercepted along a 5-m tape extending in each of the four cardinal compass directions. For each sample the coefficient of variation of intershrub distances was used as an index of dispersion; the greater the index, the more clumped the shrubs. We averaged the habitat data (exclusive of individual shrub measurements) for each grid marker and used the grid markers as observational units in statistical analyses. For individual shrub measurements (height, condition, etc.), the shrubs were the observational units.

To characterize actual nest sites, we recorded the same data for shrubs supporting a nest as for those occurring within quadrats. We also estimated canopy coverage and dispersion of sagebrush along a 5-m tape extending from the nest in each of the four cardinal compass directions. Further, we recorded the height of each sagebrush plant intercepted. From 1981 to 1984 we estimated coverage of rabbitbrush, grasses, forbs, litter, and bare ground in 20 × 50-cm quadrats placed 2.5 and 5 m from each nest in each of the four cardinal directions. To minimize the potential confounding effects of vegetation change occurring between the time of nest initiation and our measurements, we took the measurements of rabbitbrush, grasses, forbs, litter, and bare ground soon after a nest had been located. However, these measurements were not recorded for nests abandoned before being located. Data were averaged for each nest so that nests were the observational units in statistical analyses. We also recorded the following measurements: (1) height of each nest (ground to nest rim), (2) distance from the nest rim to the top of the support shrub, (3) shortest horizontal distance from the center of the nest to the perimeter of the support shrub, and (4) compass orientation of the nest relative to the center of the support shrub. We calculated relative nest height as the ratio of nest height to the height of the support shrub and expressed as a percentage.

T tests and chi-square analyses were used to compare nest-site features with those of the study area in general. For most *t* tests, variances did not differ significantly between the two groups. When variances differed, we used the t' test (Sokal and Rohlf 1969: 374–375), which relaxes the assumption of variance homogeneity. There were few significant variations among years in nest-site features used by thrashers or in habitat features on the study area. Accordingly, data were pooled for all years.

RESULTS

Nest-Site Microhabitat

Sage Thrashers chose nesting areas in which sagebrush plants were significantly taller and more clumped than on the study area in general (Table 1). Percent coverages of sagebrush, rabbitbrush, grasses, forbs, and litter within 5 m of thrasher nests were slightly greater than those on the study area in general. Although none of these patterns was significant, their cumulative effect resulted in significantly less bare ground near nests than on the rest of the study area.

Nest Substrates

All nests were located in or beneath (on the ground) sagebrush plants. Shrubs selected for nesting averaged significantly taller than those representative of the study area ($t = 15.7$, df $= 5079$, $p < .001$). Moreover, the range of shrub sizes used for nesting was much narrower than that of the available shrubs

TABLE 1. Habitat characteristics within 5 m of Sage Thrasher nests and on the study area in general ($\bar{x} \pm$ SD).

Variable	Near nests		Study area
Sagebrush height (cm)	49 ± 12 (53)[a]	*[b]	41 ± 18 (5028)
Sagebrush dispersion[c]	86 ± 19 (53)	*	77 ± 22 (401)
Sagebrush coverage (%)	23 ± 10 (53)		22 ± 11 (401)
Rabbitbrush coverage (%)	6 ± 4 (34)		5 ± 7 (484)
Grass coverage (%)	9 ± 9 (34)		8 ± 9 (484)
Forb coverage (%)	4 ± 7 (34)		3 ± 5 (484)
Litter coverage (%)	7 ± 3 (34)		6 ± 6 (484)
Bare ground (%)	50 ± 12 (34)	*	55 ± 21 (484)

[a]Sample size.
[b]Nesting microhabitat differs from study area in general ($p < .05$, t test).
[c]Coefficient of variation of intershrub distances.

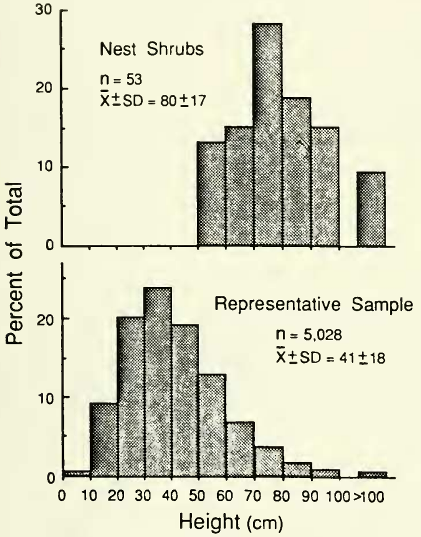

Fig. 1. Frequency distributions of heights of Sage Thrasher nest shrubs and a representative sample of sagebrush shrubs from the study area in general.

(Fig. 1). Shrubs less than 50 cm tall constituted 73% of all available shrubs; yet no shrubs in this size range were used as nest substrates. Indeed, 72% of the nests found were in or under shrubs greater than 70 cm tall; shrubs in this size range composed only 7% of all available shrubs.

Shrubs used for nesting by Sage Thrashers differed from available shrubs in several other respects. Nearly all shrubs used by thrashers were 75% or 100% living (Table 2). This differed markedly from the distribution of available shrubs among the condition classes, in which many shrubs were less than 75% living. Further, most available shrubs bearing foliage had intermediate foliage density. Although two-thirds of the nest shrubs also had intermediate foliage density, shrubs with high foliage density were used disproportionately by thrashers as nest substrates, and shrubs with low foliage density were used little. The canopy continuity of shrubs evidently did not influence shrub selection by thrashers; the frequencies with which gaps occurred in the canopies of nest shrubs and available shrubs were nearly identical. Finally, a significantly greater than expected proportion of shrubs used for nesting had branches or foliage within 30 cm of the ground.

Nest Placement Within Substrates

Thrashers placed their nests deep within or beneath shrubs (Table 3). Nest height averaged only slightly more than a third of the substrate height. Further, nests were placed horizontally relatively far from the perimeter and close to the center of the shrub. Several of these measurements are noteworthy because of their relative constancy; coefficients of variation were small for relative nest height and distances from the nest to the perimeter and the top of the shrub.

The overall pattern of Sage Thrasher nest orientations (Fig. 2) was not significantly different from a uniform distribution ($X^2 = 9.6$, 7 df, $p = .22$), but easterly (NE, E, SE) exposures were more prevalent than westerly (NW, W, SW) exposures. A comparison of all easterly orientations (combined) to all westerly orientations was significant ($X^2 = 6.1$, 1 df, $p = .02$).

DISCUSSION

Sage Thrashers were selective in their choice of nest sites. In microhabitats chosen

TABLE 2. Comparisons of Sage Thrasher nest shrubs with a representative sample of sagebrush shrubs from the study area in general. Values represent frequencies of occurrence and percentages (in parentheses) of the total.

Variable	Nest shrubs	Representative sample	χ^2	p
Condition			27.15	< .01
Dead	1 (2)	1109 (22)		
25% living	0	312 (6)		
50% living	2 (4)	617 (12)		
75% living	13 (24)	709 (14)		
100% living	37 (70)	2269 (45)		
Foliage density			5.87	.05
Low	3 (6)	515 (13)		
Intermediate	35 (67)	2762 (71)		
High	14 (27)	632 (16)		
Canopy continuity			0.01	.99
With gaps	22 (42)	2041 (41)		
Without gaps	31 (58)	2959 (59)		
Profile			4.91	.03
Full[a]	49 (92)	1875 (80)		
Not full	4 (8)	461 (20)		

[a]Branches or foliage within 30 cm of the ground.

TABLE 3. Aspects of nest placement by Sage Thrashers.

Variable[a]	$\bar{x}$	SD	CV
Nest height (cm)	30	13	43
Relative nest height (%)	37	12	33
Horizontal distance to perimeter (cm)	33	8	25
Horizontal distance to center (cm)	17	10	63
Distance to top (cm)	47	11	24

[a]n = 53 for all variables.

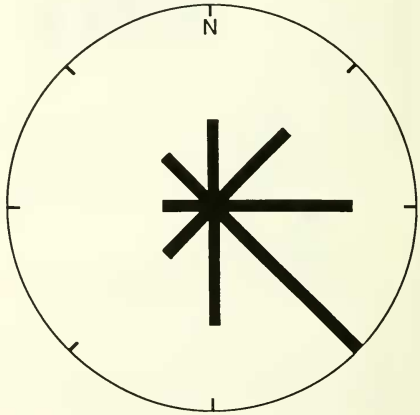

Fig. 2. Distribution of Sage Thrasher nest orientations (n = 53) relative to the center of the support or overhead (for ground nests) shrub. The length of each bar is proportionate to the number of nests having that orientation.

for nesting, the coverage of sagebrush seemingly was not important, but the size and spatial distribution of the shrubs were. And thrashers seemed to select areas in which total vegetation coverage was sufficient to lessen the amount of bare ground. Other studies also have documented nonrandom use of microhabitat for nest sites (e.g., MacKenzie and Sealy 1981, Petersen and Best 1985). Further, shrubs selected as nest substrates differed from the sample of shrubs representative of the study area in nearly every character that we measured.

Ultimate causes of nest-site selection patterns of Sage Thrashers are unknown, but two likely selective agents are predation pressure and microclimate. For example, Sage Thrashers may place their nests in large shrubs because their nests are large and bulky (personal observation) and would be less conspicuous in large than in small shrubs. Placement of nests in living shrubs, in shrubs with high foliage density, and in shrubs with branches and foliage within 30 cm of the ground could be influenced by the need for concealment or cover from predators or weather. Nest concealment in birds is related in part to probability of predation or amelioration of microclimate (e.g., Pleszczynska 1978, Wray and Whitmore 1979, Murphy 1983, Martin and Roper 1988). The potential importance of nest obscurement and cover for thrashers is suggested also by observations of platforms of twigs in shrub canopies above some nests (Rich 1980, 1985; personal observation). Rich (1980) believed that some such canopies were old nests, but none that we observed appeared so. In one instance that we observed, twigs were placed in the shrub canopy about one week after the nest was initiated.

Aspects of nest placement within substrates (e.g., nest height, nest orientation) also have been found to be related to nesting success (e.g., Murphy 1983, Westmoreland and Best 1985) and microclimate amelioration (Horvath 1964, Rich 1978). In particular, nonrandom nest orientation typically is thought to reflect responses by birds to prevailing winds or the radiative environment (e.g., Austin 1976, Petersen and Best 1985, Ferguson and Siegfried 1989). Favoring easterly and avoiding westerly exposures for nests may reflect attempts by thrashers to maximize exposure to the morning sun, shading from the afternoon sun, or both.

It is possible, of course, that factors other than predators or microclimate accounted for the patterns we observed. For example, selection of a large shrub for nesting may denote the need for structural support for the nest. The tendency of Sage Thrashers to select microhabitats with large, clumped shrubs might simply reflect the spatial distribution of areas conducive to robust sagebrush growth. Thus, selection of a large shrub for nesting could, de facto, place the nest in an area of large, clumped sagebrush. Or, because thrashers forage primarily on the ground (personal observation), clumped shrubs perhaps provide a favorable interspersion of shrubs and openings for foraging near the nest.

Although the determinants of nest-site selection by Sage Thrashers are not known for certain, several lines of evidence suggest that thrasher nest-site selection is strongly stereotypic. First, the use of sagebrush plants as nest substrates is ubiquitous. Reynolds and Rich (1978), Rich (1978, 1980), and Reynolds (1981) also found nests only in or under big sagebrush plants. Castrale (1982) found one thrasher nest in a juniper (*Juniperus osteosperma*) tree. To our knowledge, this is the only documented instance of a Sage Thrasher nest in anything but sagebrush. Second, Sage Thrashers are specific in that their nest sites differ in many respects from the average available habitat. Third, variation in the height of shrubs chosen (coefficient of variation = 21%, compared to 44% for the representative sample of shrubs from the study area) and in several of the nest placement variables is small (Table 3). Moreover, the mean nest shrub height is similar to means reported in other studies (Reynolds and Rich 1978, Rich 1980, Reynolds 1981, Castrale 1982). Sage Thrashers are characteristic of most sagebrush-dominated rangelands in the United States (Wiens and Rotenberry 1981), and because thrashers have evolved in sagebrush habitat, the specificity of their nest-site selection should not be surprising. The patterns that we observed likely have been molded by a long history of exposure to a particular suite of selective agents.

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